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STANDARDS SUPPORT AND ENVIRONMENTAL IMPACT STATEMENT VOLUME 2: PROMULGATED STANDARDS OF PERFORMANCE FOR LIGNITE-FIRED STEAM GENERATORS

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Volume 1 discussed the proposed standard and the resulting environmental and economic effects.

16. ABSTRACT
A standard of performance for the control of emissions of nitrogen oxides from new and modified lignite-fired steam generators is being promulgated under the authority of section 111 of the Clean Air Act. When standards of performance for large steam generators were promulgated under Subpart D of Part 60, lignite-fired units were exempted from the nitrogen oxides standard (the sulfur dioxide and particulate matter standards are applicable to lignite-firing) because of a lack of data on attainable levels of emission from such units. Since then, sufficient data have been obtained to propose and promulgate a standard. This document contains summaries of public comments on the proposed standards, EPA responses, a discussion of differences between the proposed and promulgated standards, and the final environmental impact statement as submitted to the Council on Environmental Quality.

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Emission Standards and Engineering Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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Final Standards Support and Environmental Impact Statement

Lignite-Fired Steam Generators

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I. INTRODUCTION AND RATIONALE FOR THE FINAL STANDARD

In 1971, the U. S. Environmental Protection Agency (EPA) set air emission standards for new steam generators with heat input rates greater than 73 MW (250 million Btu/hr). Lignite-fired steam generators were exempted from the emission standards for nitrogen oxides (NO_x) because too little operating experience was available to adequately characterize NO_x emissions. Since 1971, EPA has gathered additional information on lignite-fired steam generators, and on December 22, 1976, the Agency proposed a standard which would limit NO_x emissions from these facilities to 260 ng NO_x/J (0.6 lb NO_x/million Btu). Supporting information for the proposed standard was published in the Standards Support and Environmental Impact Statement (SSEIS), Volume 1: Proposed Standards of Performance for Lignite-Fired Steam Generators (EPA-450/2-76-030a). After reviewing issues raised during the public comment period which followed the proposal, the Agency decided to promulgate two separate standards for the two basic types of large lignite-fired boilers. The final standards limit NO_x emissions to 260 ng NO_x/J (0.6 lb NO_x/million Btu) from lignite-fired steam generators except 340 ng NO_x/J (0.8 lb NO_x/million Btu) is allowed from cyclone-fired steam generators which burn lignite mined in North Dakota, South Dakota, or Montana. Both standards apply only to boilers which burn lignite, with heat input rates greater than 73 MW, and for which construction or modification began on or after the date of proposal, December 22, 1976.

The NO_x standard originally proposed by EPA, 260 ng NO_x/J (0.6 lb NO_x/million Btu), may have prevented the use of cyclone-fired boilers, since it has not been demonstrated that emissions from these units can be consistently controlled to levels below 260 ng NO_x/J. During the public comment period, several commenters argued that utilization of the cyclone-fired boiler is necessary to overcome the serious fouling and slagging problems which develop whenever the sodium content of the lignite burned exceeds about 5 percent, by weight. These high sodium content reserves are believed to be widespread, especially in North Dakota, and the utilities claim that their low sodium content reserves are being rapidly depleted. The commenters said that cyclones have inherently lower fouling and slagging rates than other large boiler designs because much less ash is carried through the boiler convective passes. In addition, they contended that in the Dakotas there has actually been very little operating experience with pulverized-fired boilers, the alternative to large cyclones, and it is doubtful that these units can burn high sodium lignite without experiencing severe problems. Thus, the commenters concluded that the proposed standard might indirectly restrict the use of valuable resources of high sodium lignite fuel by prohibiting the utilization of cyclone-fired boilers. The commenters also argued that the proposed standard would place an economic burden on the electric power utilities which use lignite by limiting competitive bidding for new boilers.

When the original standard was proposed, EPA believed that pulverized-fired boilers could be designed to burn high sodium content lignite as reliably as cyclones and still emit lower levels of NO_x. This position was supported with: (1) emission data from two tangentially-fired power plants,

one horizontally-opposed-fired plant, and one cyclone-fired plant, (2) reported successful operating experience from a front wall-fired plant, (3) a utility's recent decision to purchase two tangentially-fired boilers to burn North Dakota lignite, and (4) the assurance of a major boiler manufacturer that its new tangentially-fired boilers could achieve NO_x emissions as low as 220 ng NO_x/J (0.5 lb NO_x/million Btu) when burning lignite. During the public comment period, this supportive information was criticized as being insufficient to justify restriction of the cyclone-fired boiler. In particular, the commenters made these arguments:

- The tangentially-fired boilers which EPA tested only burned Texas lignite; therefore, these units were not subject to the high fouling tendency of North Dakota lignite.

- The horizontally-opposed-fired boiler which was tested by EPA experiences extensive fouling and slagging whenever high sodium lignite is burned. Derating of the unit has been prevented by selectively mining lignite to achieve sodium levels below five percent.

- The cyclone-fired boiler which EPA tested has a good record of reliability. (However, the unit has not burned the high sodium lignite for which it was designed.)

- The front-wall-fired boiler has never burned lignite with an eight percent sodium content for an extended period of time, as EPA has reported. Generally, sodium levels have ranged from only four to six percent since 1971. Also, the unit's capacity factor since 1971 has averaged about 72 percent, not 86 percent as stated by EPA. There have been numerous slag outages and induced load reduction due to heavy slagging, and the unit has been derated from 170 to 130 MW.

- Although it is true that a North Dakota electric utility has recently agreed to purchase two tangentially-fired boilers, these units are guaranteed to burn lignite containing no more than 4.8 percent sodium. Also, these units were designed with 10 times extrapolation of experience. The decision to purchase these boilers may have been influenced by the utility's concern that EPA might prohibit the use of cyclones.

- Manufacturer's guarantees should not be relied upon until successful operation of their units with high sodium lignite has been demonstrated.

Also discussed during the comment period was a recent study by the Energy Research and Development Administration which demonstrated that test coupons placed inside a cyclone-fired boiler had significantly lower ash deposition rates than those located inside a pulverized-fired boiler. Both of these units burned identical lignite fuel containing 3.6 percent sodium in the ash. The results of this study tend to confirm arguments that cyclones are less likely to experience fouling and slagging problems due to the sodium content of fuel.

EPA agrees that at present there has not been enough operating experience with pulverized- or cyclone-fired boilers to be able to predict their reliability when burning high sodium lignite. Furthermore, the Agency does not want to establish a standard which might inhibit future efforts to find a successful way to burn this troublesome fuel. Consequently, EPA has established a separate nitrogen oxides emission standard of 340 ng/J (0.8 lb/million Btu) for new cyclone-fired boilers which burn lignite mined in North Dakota, South Dakota, or Montana. This standard will permit the limited utilization of cyclone-fired boilers and assure the continued use of our country's abundant resources of lignite. The standard is supported by emission test data and other information contained in Volume I of the SSEIS. Nitrogen oxides emissions from pulverized-fired boilers will be limited to 260 ng NO_x/J (0.6 lb NO_x/million Btu), as originally proposed.

Cyclone-fired boilers could account for 10 to 20 percent of all new lignite-fired steam generators, based on EPA estimates of lignite consumption for the year 1980. EPA estimates that NO_x emissions from new cyclones may be reduced by as much as 20 percent as a result of the standard. The combined effect of both standards will be to reduce total NO_x emissions from all boilers which burn lignite by about 25 percent. The continued construction

of new cyclone-fired boilers should have a minor adverse impact on ambient air quality, as discussed in Chapter III: Environmental Impact Summary.

Other issues were raised during the public comment period, and these are discussed in Chapter II: Public Comment Summary.

II. PUBLIC COMMENT SUMMARY

Upon proposal of the NO_x emission standard for lignite-fired steam generators, the public was invited to participate in the rulemaking process by submitting written comments to the Agency. Seventeen comment letters were received - nine from electric power utilities, four from Federal and State agencies, two from boiler manufacturers, one from a trade association, and one from a private industry. The comment letters, many containing multiple comments, were carefully reviewed and were useful in determining the final standards. A list of commenters, a summary of their major comments, and EPA's responses to these comments follow.

List of Commenters

L-1	E. B. Robison State of Maryland Department of Health and Mental Hygiene
L-2	William B. Hewitt U. S. Department of Labor
L-3	D. M. Fowler Federal Energy Administration
L-4	R. P. Welden Foster Wheeler Energy Corporation
L-5	John W. Turk, Jr. Southwestern Electric Power Company
L-6	J. A. Barsin Babcock and Wilcox

L-7 Jay D. Myster
Otter Tail Power Company

L-8 Perry G. Brittain
Texas Utilities Services, Inc.

L-9 Lloyd V. Hillier
Minnkota Power Cooperative, Inc.

L-10 D. C. Kettner
United Power Association

L-11 C. L. Knowles, Jr.
Olin Corporation

L-12 Charles Custard
Department of Health, Education, and Welfare

L-13 F. K. Smith
Texas Municipal Power Agency

L-14 G. R. Coffman
Texas Power and Light Company

L-15 R. W. Cox
Dallas Power and Light Company

L-16 Kenneth J. Fiedler, Jr.
City Public Service Board of San Antonio, Texas

L-17 W. H. Axtman
American Boiler Manufacturers Association

Summary of Comments With Responses

1. Restricted Use of the Cyclone Boiler, L-6, 7, 9, 11, 13

Comment: The proposed standard would effectively prevent use of the cyclone-fired boiler when burning lignite. This would be a mistake because it is generally believed that cyclone units must be used to overcome the severe boiler fouling problems which develop from burning the high sodium lignite found primarily in North Dakota. The Energy Research and Development Administration has recently confirmed that cyclone-fired units have a significantly lower ash deposition rate than pulverized-fired units. This is logical, since much less ash is carried to the boiler convection surfaces with cyclones than with pulverized-fired units.

Existing pulverized-fired boilers have required various design modifications when burning high sodium lignite. These modifications include increased boiler tube spacing, additional soot blowers, the use of high pressure water lancers, and fuel blending. Yet even with these changes, pulverized-fired units can operate at full load for only a short period of time while burning lignite with an ash containing more than four percent sodium. Sodium contents as high as 10 to 16 percent are expected in the future. Unfortunately, little operating experience with high sodium lignite is available with either cyclone- or pulverized-fired units.

In addition to the reduced fouling characteristics of the cyclone-fired boiler, there are several other advantages to this boiler design. For example, cyclone units actually emit lower levels of particulates than conventicnal dry bottom boilers. Thus, the incremental cost of a larger electrostatic precipitator for a dry bottom unit could approach $40/kW (or, 100 percent) over the cost for a cyclone unit. Also, in contrast to coal pulverizers, cyclone boiler coal crushers require much lower maintenance costs, consume about half as much power, cause fewer load curtailment, and minimize the possibility of fire or explosion. By applying the proposed standard only to Texas lignite or pulverized-fired boilers, EPA would be able to achieve about 80 percent of the proposed NO_x reduction by 1985 while still allowing extensive resources of North Dakota lignite to be utilized.

Response: EPA recognizes that there may be advantages to using cyclone-fired boilers when high sodium lignite is burned and does not

believe that it would be in the public interest to restrict the use of this valuable energy resource. Therefore, EPA has decided to establish an NO_x emission standard of 340 ng NO_x/J (0.8 lb NO_x/million Btu) for new cyclone-fired steam generators which burn lignite mined in North Dakota, South Dakota, or Montana and with heat input rates greater than 73 MW (250 million Btu/hour). This standard will permit the limited utilization of new cyclone-fired units and assure the continued use of valuable resources of high sodium lignite. The emission standard will remain at 260 ng NO_x/J (0.6 lb NO_x/million Btu) for all other lignite-fired boiler designs with heat input rates greater than 73 MW. Steam generators with heat input rates less than 73 MW are not subject to any Federal standards of performance for new stationary sources at this time.

2. Operating Experience and Reliability, L-4, 6, 9, 10, 12, 13

Comment: EPA states that the United Power Association's front wall-fired plant in Stanton, North Dakota, has operated at 86 percent capacity and has not been shut down to deslag for one year. This is incorrect. The plant's capacity factor has averaged about 72 percent since 1971, and there have been numerous slag outages and induced load reductions due to heavy slagging. The unit has been derated from 170 to 130 MW. Also, the Stanton Plant has never experienced sodium levels of eight to nine percent in the ash for any extended period of time, as reported by EPA. Although scattered individual samples have shown sodium in the ash to be slightly over eight percent, this level was never maintained over an extended period of time. Thus, the effect of continuous use of high sodium lignite on unit operation has never been established. Further derating of the unit will be necessary if high unit reliability is to be achieved with fuels in the seven to nine percent sodium range. (The commenters support these statements

with annual average capacity factors, average capacities, deslagging outages, and slag induced load reductions for the years 1971 through 1976, and ash sodium contents for the years 1973 through 1976).

The two tangentially-fired plants in Texas which were tested by EPA did not burn Dakota lignite and, therefore, were not subject to the high fouling tendency of this fuel. Although it is true that a North Dakota electric utility has recently agreed to purchase two tangentially-fired boilers, these units are guaranteed to meet Federal standards only if they burn lignite containing no more than 4.8 percent sodium. Also, these units are designed with ten times extrapolation of experience. The decision to purchase these boilers was influenced by the utility's concern that EPA might prohibit the use of cyclones.

EPA has tested two other plants in support of the proposed standard. One, a horizontally-opposed-fired unit, has experienced major fouling problems whenever the lignite sodium content exceeds five percent. The other, a cyclone, has a very good record of operating reliability. This plant, however, has not been firing the high sodium fuel for which it was designed. Based on the reliability of this cyclone, four 425 MW cyclone-fired units have been ordered by Dakota utilities. Two of these came on line in 1975, one is starting up now, and the other unit will come on line in 1981.

It is apparent that EPA's contention that pulverized-fired units can handle high sodium lignite as well as cyclones cannot be supported at this time. Several more years of operating experience are necessary to assess the reliability of these units when firing this difficult fuel.

Response: EPA agrees that there is presently little operating experience with high sodium lignite, and that cyclone-fired boilers may be required to effectively burn this difficult fuel when sodium levels exceed about five percent. For this reason, EPA has established a separate emission standard for new cyclones burning lignite mined in North Dakota, South Dakota, or Montana which will permit their continued use.

EPA obtained its Stanton plant operating data during a telephone conversation with plant management. We regret any misunderstanding.

3. Texas Lignite Nitrogen Content, L-3, 8, 13, 14, 15, 16, 17

Comment: EPA based the proposed standard, in part, on emission data from Dallas Power and Light's Big Brown plant. This was the only lignite-fired plant tested by the Agency in Texas, and the nitrogen content of the lignite it burned was rather low, about 0.7 percent by weight (as received). Our data show, however, that the fuel-bound nitrogen content of Texas lignite is actually much higher, varying from 0.85 percent in Harrison County to 1.57 percent in Leon County. Since NO_x emissions increase with the nitrogen content of the fuel, the proposed NO_x emission standard might prohibit the use of many Texas lignite reserves with nitrogen contents higher than those experienced at the Big Brown plant. Such a prohibition could restrain the use of a valuable energy resource and would place an economic burden on those utilities which have already acquired the rights to these high nitrogen lignites. In addition, some utilities might be forced to import coal from other States. This would increase the price of fuel by at least $10/ton, thus effectively doubling an electric utility's annual production costs. (One commenter supports his statements with a tabulation of proximate and ultimate analyses for lignites in thirty-one Texas counties).

Also, EPA is wrong in stating that the NO_x emissions from lignite-fired power plants will be lower than from bituminous coal-fired units simply

because the average nitrogen content of lignite is only about 0.7 percent (on an as-received basis) in contrast to bituminous coal nitrogen contents which range from 0.7 to 2.0 percent. Since the heating value of lignite is frequently less than half the heating value of bituminous coal, often twice as much lignite must be burned in a steam generator to produce the same power. Consequently, more fuel-bound nitrogen will also be consumed during combustion of lignite than of bituminous coal, and this will generate higher, not lower, NO_x emissions.

Response: The data submitted by the commenter on Texas lignite nitrogen contents was published in 1963 by the Bureau of Economic Geology at the University of Texas, Austin. A Bureau official has told EPA that these data, although published in 1963, were actually accumulated around the turn of the century, and are not consistent with present-day values. The Bureau has unpublished results of more recent scattered samplings of Texas lignite, and in no instance does this information show fuel nitrogen contents above 1.0 percent, by weight (as received). This is a relatively low value and should not cause emissions from a well controlled plant to exceed the standard. The Texas Railroad Commission also has information which shows that the nitrogen content of Texas lignite is quite low, averaging less than 0.5 percent, by weight (as received).

The nitrogen content of lignite cannot be used alone to accurately estimate NO_x emissions, as implied in the comment. Although recent experiments indicate that most of the NO_x generated during the combustion of coal is derived from fuel-bound nitrogen, the quantitative relationship between the nitrogen content of coal and NO_x emissions is not well understood. It is known from operating experience with large power

plants that the efficiency of conversion from fuel-nitrogen to NO_x varies from about 25 to 50 percent, and that this conversion efficiency actually decreases as the nitrogen content of the fuel increases. In addition, EPA-sponsored tests have proven that emissions of thermal and fuel NO_x are reduced by firing with a combination of staged combustion and low excess air. The high moisture content of lignite may or may not be a critical factor when considering fuel-nitrogen conversion to NO_x. However, the lower flame temperatures resulting from the combustion of this high moisture fuel diminish the formation of thermal NO_x and thus generally reduce total NO_x emissions below typical values for other coals.

Properly controlled tangentially-fired power plants which burn bituminous coals can comply with a standard of 260 ng/J (0.6 lb/million Btu) even when burning coals with fuel-nitrogen contents well above 1.0 percent. Based, in part, on this experience with bituminous coal-fired units, EPA believes that lignite-fired plants, even with fuel-nitrogen contents above 1.0 percent, can also achieve NO_x emission levels below 260 ng/J, since the lignite and bituminous coals under consideration have comparable heating values and fuel-nitrogen contents (when compared on a dry, ash-free basis). This conclusion has been confirmed with emission tests at several lignite-fired facilities.

A commenter has argued that since more lignite must be burned to produce the same power as other coals, more fuel-nitrogen will be consumed, and NO_x emissions will be higher. This, however, is not reasonable because the measured nitrogen content of coal is associated with combustible matter only, not with the moisture and ash contents of the coal. When lignite and other coals are compared on a dry, ash-free basis, their fuel-nitrogen

contents and heating values are similar, and their ratios of fuel-nitrogen to combustible matter [expressed as %N/(Btu/lb)] are nearly the same. An example of this is presented on the chart below which was derived from data contained on page II-2, Volume 1 of this standards support and environmental impact statement for lignite-fired steam generators. Thus, a lignite-fired plant will consume about the same amount of combustible matter and fuel-nitrogen as a comparable coal-fired plant even though the lignite-fired unit will actually burn a larger quantity of fuel (as received).

	Bituminous	Subbituminous	Lignite
Heating Value (Btu/lb) dry, ash-free	14,200 - 11,700	17,100 - 12,300	13,500 - 10,30(
Fuel-Bound Nitrogen (% by weight) dry, ash-free	1.6	1.4	1.2
$\frac{\%N}{(Btu/lb)} \times 10^4$	1.1 - 1.4	0.8 - 1.1	0.9 - 1.2

EPA will continue to evaluate this problem as new evidence becomes available. However, at this time we have no reason to believe that the combustion of high nitrogen Texas lignite will cause the emissions from any well controlled pulverized-fired boiler to exceed 260 ng NO_x/J (0.6 lb NO_x/ million Btu).

4. Economic Analysis, L-5, 6, 9, 10, 11, 13

Comment: The economic analysis for the proposed standard has several shortcomings. First, EPA incorrectly assumes that the operating costs for cyclone- and pulverized-fired units are about the same. For example, a cyclone boiler's fuel crushers cost only two to three cents per ton for maintenance. In contrast, pulverizers require 10 to 20 cents per ton for maintenance, consume about twice as much power, cause more load curtailments, and increase the possibility of fire or explosion. Also, the incremental

cost of the larger electrostatic precipitator required by a pulverized-fired unit could approach $40/kW (or 100 percent) over the cost for a cyclone-fired unit. Cyclone-fired units for North Dakota lignite have shown, on a recent bid, some minor cost savings over pulverized-fired units due to the smaller size of the furnace and reduced building volume.

EPA incorrectly states that there are no significant differences between the capital costs for lignite-fired and coal-fired plants. Actually, a steam generator designed to burn North Dakota lignite must be about 30 percent larger than an equivalent unit designed to burn bituminous or subbituminous coal; and the price differential between the two is also about 30 percent.

Also, the cost of Texas lignite is greater than EPA's estimates. EPA assumes that lignite prices are stable or decreasing, that most existing mines have long-term contracts or are captive mines, and that lignite prices peaked in 1974. However, EPA considered only those mines which opened before 1970, and these do not represent future lignite prices. The industry projects that a new mine will produce lignite at $7 to $10/ton, based on overburden to seam thickness ratios of more than 15:1. (Present ratics are 10:1 or less). With the advent of more mines, the average cost of lignite mines in Texas will rise significantly by 1980.

Finally, the 0.5 percent increase in new plant investment costs resulting from NO_x control would all be unfairly passed on to the consumer.

Response: Although there are some minor cost advantages to cyclones over pulverized-fired boilers, the actual baseline investment and operating costs for field-erected central station steam boiler units are largely a function of plant size and fuel characteristics and not of burner design.

A 30 percent increase in the investment costs of a new lignite-fired boiler might also increase the investment costs associated with NO_x control methods. However, the percentages by which power plant investment and operating costs would increase as a result of implementing NO_x controls would not significantly change. These percentages would remain below 0.5 percent and are too small to have a significant economic impact on the producers or consumers of electricity.

The purpose of EPA's analysis of the cost of Texas lignite was to demonstrate that NO_x control techniques will not directly affect the price of lignite. This remains true regardless of the price of lignite for two reasons. First, NO_x controls do not significantly alter boiler efficiency. Thus, the consumption of lignite per kWh remains essentially unchanged. Also, NO_x controls will not encourage the use of other coals by restricting the use of lignite. Therefore competitive pricing between lignite and other coals will not be disturbed.

The cost of power to the consumer is generally proportional to the cost of production for the utility as a whole. Assuming that NO_x emission levels at a model 750 MW plant are reduced from 340 to 220 ng NO_x/J (0.8 to 0.5 lb NO_x/million Btu), the annual production costs would increase from about 8.50 to at most 8.53 mills/kWh, or 0.35 percent. If the emissions from existing power plants are controlled at their present level, the incremental increases in consumer power costs due to new plants would be even less than 0.35 percent. EPA considers this an insignificant price to pay for the resulting improvement in air quality.

5. Competitive Advantage, L-3, 7, 8, 9, 10. 14, 15, 16

Comment: The proposed standard might give a competitive advantage to the manufacturer of tangentially-fired boilers since the designs of the other manufacturers may be unable to achieve this emission limitation. This could lead to a monopoly in sales, compromised quality, and inflated prices. EPA has failed to analyze the adverse economic impact the standard would have on utilities by restricting their right to solicit competitive bids.

Response: EPA has revised the proposed emission standard to permit the limited use of cyclone boilers since these units may be required to burn high sodium lignite. This decision will substantially relieve any competitive advantage problem.

6. Technology, L-4, 6, 9, 12

Comment: The best system for reducing NO_x emissions may not be a combination of staged combustion and low excess air, as reported by EPA. Although it has been demonstrated that NO_x emissions can be lowered with this system, there is no long term experience to demonstrate the effects on slagging, fouling, carbon loss, furnace and burner stability, and furnace tube wastage. Furthermore, the combination of staged combustion and low excess air have not been tested with Dakota lignite.

Response: Although there may be some disagreement about the best method for reducing NO_x emissions, the combination of low excess air and staged combustion has proven to be particularly effective. Since 1971 when Federal NO_x emission standards for coal-fired steam generators were established, most new boiler designs have successfully incorporated this emission control combination. There is no reason to believe that lignite cannot be successfully burned in units designed for low NO_x emissions,

except for those situations when the sodium content is high. For these situations, EPA has set a higher NO_x emission standard which will permit the use of cyclone boilers.

Comment: EPA presents no proof that NO_x reduction methods have no effect on energy production efficiency.

Response: Low NO_x operation can actually increase boiler efficiency by reducing excess air which would otherwise carry valuable combustion heat out the stack. Generally, this effect more than balances efficiency losses which can result from incomplete combustion.

Comment: EPA's determination that the ash fouling problem can be minimized by using more soot blowers, using larger spaces between boiler tubes, and designing the furnace temperature to control tube metal temperatures is an oversimplification of the problem. Changes in unit size, pressure, firing methods, and furnace designs and differences in fuel all affect the fouling problem. In addition, a standard as low as 260 ng NO_x/J (0.6 lb NO_x/million Btu) will aggravate boiler tube fouling and slagging by limiting the flexibility of certain operational parameters such as excess air.

Response: EPA recognizes that too little operating experience is presently available to predict, under all circumstances, the best solution to the fouling problem. Consequently, EPA has decided to permit the limited use of the cyclone-fired boiler due to its low fouling character when firing high fouling lignite mined in North Dakota, South Dakota, or Montana.

7. Uniform NO_x Standards for all Coals, L-3, 8, 11, 14, 15, 16

Comment: The proposed standard sets a lower NO_x emission limitation for lignite than for other coals. This seems unfair, especially considering that the emission factors for controlled pulverized firing of lignite and

other coals are essentially the same. Furthermore, many coals defy classification as to whether they are lignitic or bituminous. And finally, the proposed standard might discourage the use of lignite in favor of other coals, and this would waste a valuable energy resource.

Response: The NO_x emission standard for steam generators which burn coal (except lignite), 300 ng NO_x/J (0.7 lb NO_x/million Btu), was established in 1971 when less was known about NO_x control methods. At that time a lower emission standard could not be justified. Now, however, control technology advances and the availability of greater operating experience have encouraged EPA to seriously consider revising the standard (EPA expects to propose this standard early in 1978). Thus, the proposed NO_x emission standards for lignite- and coal-fired steam generators would be similar (except for lignite-fired cyclone boilers burning lignite mined in North Dakota, South Dakota, or Montana which will be limited to 340 ng NO_x/J [0.8 lb NO_x/million Btu]).

8. Environmental and Health Effects, L-5, 8, 9, 12, 14, 15, 16

Comment: EPA states that tangentially-fired boilers may be able to achieve emissions as low as 220 ng NO_x/J (0.5 lb NO_x/million Btu). Therefore, the proposed standard of 260 ng NO_x/J (0.6 lb NO_x/million Btu) is higher than necessary and seems to compromise public health for the sake of assuring competition between the boiler manufacturers. If this is so, EPA should use dispersion modeling to estimate what the health effects of NO_x emissions will be in regions where the new lignite-fired steam generators will be located.

Response: New source performance standards are based on the best adequately demonstrated technological system of continuous emission reduction considering the cost of achieving that reduction, and any non-air quality, health, environment and energy impacts; they are not based directly on protection of public health. Public health was considered

when steam generators and other air pollution sources were given high priorities for regulation under section 111 of the Clean Air Act. EPA believes that there is insufficient evidence at this time to justify a standard lower than 260 ng NO_x/J based on best technology, considering costs. Dispersion modeling was used to evaluate maximum ambient NO_x concentrations at ground level from model facilities. The maximum annual average concentration of NO_2 at ground level would typically be about 1 to 2 ng/m^3 for cyclone emission rates and proportionally less for the other furnace designs with lower emission factors. This concentration is well below the primary national ambient air quality standard of 100 µg/m^3 for NO_2. The primary standard reflects the maximum allowable ambient concentration of NO_x necessary to protect public health.

Comment: EPA attempts to proportionally correlate the formation of atmospheric oxidants with NO_x emissions. Although the study shows that NO_x ground level concentrations would be quite low, the actual atmospheric conditions which are pertinent to smog formation are not discussed. Also, the analysis, which is based on NO_x/hydrocarbon interaction data from Ohio and Idaho, cannot be applied to conditions in Texas. This is because recent studies on smog formation indicate that local background concentrations are very important in determining local ozone concentrations. Smog formation and the resulting health effects are extremely complicated concepts and require detailed regional assessment, not broadly generalized conclusions.

Response: NO_x and hydrocarbons (HC) are necessary precursors to the formation of photochemical oxidants (smog). These precursors may be present in the rural areas of Texas and other states as a result of:

(1) emissions from natural sources such as vegetation or natural gas deposits, (2) emissions from anthropogenic sources such as power plants, and (3) transport from urban areas. Transport of urban pollution has been documented for distances as great as 80 km (50 miles), and strongly indicated for distances of 700 km (435 miles). Investigations show that pollutants in rural areas often combine to generate appreciable quantities of smog over wide areas. In addition, these studies indicate that the addition of small amounts of NO_x to mixtures having high HC/NO_x ratios enhances oxidant formation. Since a number of investigators have reported high HC/NO_x ratios in rural air samples, the control of NO_x emissions in rural areas will help prevent an increase in rural oxidant levels. EPA's discussion of oxidant formation is only intended to demonstrate the potential for smog formation in generalized rural areas and is not meant to specifically define oxidant problems in Texas. More information may be found in Chapter VIII, Volume 1 of this standards support and environmental impact statement for lignite-fired steam generators.

Comment: EPA has presented no data on trace metal analysis of the fly-ash. Without this information, plus hydrological and geochemical data on landfill areas, it is difficult to say that there would be no adverse environmental problems from landfilling this material, or from placing it back into the mine.

Response: The NO_x emission standards are not expected to alter the proportion of dry and wet bottom boilers in use. Consequently, the relative amounts of dry and wet ash requiring disposal should not change. Furthermore, NO_x emission controls will not significantly alter the quantity, quality, or means of disposal of bottom or flyash. The environmental impact analysis for

the proposed standard only considers changes in the environment which will directly result from implementation of emission control techniques.

Comment: NO_x control methods cause higher emissions of soot, carbon monoxide, and unburned hydrocarbons. Higher hydrocarbon levels at lower NO_x levels could result in significantly increased particulate removal costs.

Response: NO_x emission control methods will cause higher emissions of these products of incomplete combustion only if the boiler combustion efficiency is reduced. However, if a boiler is properly operated, combustion efficiency will not suffer, and it may even improve.

Comment: Neither Texas nor North Dakota have been classified as non-attainment areas for ambient NO_2 pollution, or as having the potential for not being able to maintain ambient NO_2 standards in the future. An emission limitation as severe as the proposed standard should be limited to areas with ambient NO_2 problems.

Response: The control of NO_x emissions in Texas and North Dakota is important for several reasons. First, these regions have a potential for growth as population centers, or more likely as energy producing and exporting centers. This may lead to high levels of ambient NO_x in the future if emission regulations are not promulgated now. Also, rural NO_x can be transported long distances and aggravate pollution problems already existing in urban areas. And finally, it has been demonstrated that even small amounts of NO_x can combine with existing pollutants in rural areas to form widespread smog. EPA considers the emission reductions gained by the proposed standard to significantly contribute to the improvement of our nation's environmental quality.

Comment: The proposed standard would reduce nationwide NO_x emissions from all steam electric generating stations by an insignificant amount,

since lignite-fired power plants comprise less than one percent of the total U. S. generating capacity. How can a standard which has only a minimal impact on air quality be justified?

Response: The proposed standard would only nominally reduce nationwide NO_x emissions. However, since most new lignite-fired power plants will be located in Texas or North Dakota, the impact of NO_x emission regulations in these areas will be pronounced. This is discussed in more detail in the previous comment and response.

Comment: EPA states that 25 new lignite-fired steam generators would be subject to the proposed standard by 1985. Yet, we believe that construction will begin on only 10 new plants, at most, by 1985--five in North Dakota, and no more than five in Texas. Therefore, the estimated reduction in NO_x emissions which would result from the proposed standard is overstated.

Response: The installed generating capacity of new lignite-fired steam generators has grown at an average rate of 20.7 percent per year from 1972 to 1980. If this average annual growth rate remains unchanged, then the total installed lignite generating capacity should increase by 16,000 MW during the years 1980 to 1985. Sixteen thousand MW represents about 25 new plants rated at 640 MW each. EPA recognizes that the projected growth rate may vary according to economic factors, and that a lower growth rate would result in NO_x emission reductions below our estimates.

9. Applicability, L-7

Comment: To which new sources will the proposed standards apply, if promulgated?

Response: The standards apply to any lignite-fired steam generators with heat input rates greater than 73 MW (250 million Btu per hour), the

construction or modification of which is commenced on or after the date of proposal, December 22, 1976. Units built before this date or units with heat input rates less than 73 MW are exempted from all Federal standards of performance for new stationary sources at this time.

10. Coal Refuse, L-17

Comment: The proposed standard would not apply when 25 percent, by weight, or more coal refuse is burned in combination with gaseous, liquid, or other solid fossil fuels or wood residue. Please define "coal refuse."

Response: "Coal refuse" means waste-products of coal mining, cleaning, and coal preparation operations (e.g., culm, gob, etc.) containing coal, matrix material, clay, and other organic and inorganic materials. This definition appears in 40 CFR 60.41(c) and was published in the January 16, 1975, Federal Register (40 FR 2803).

11. Standardized Temperature, L-1

Comment: The proposed adoption of 293 K (20°C) as a standard condition would be incompatible with the widespread use of 298 K (25°C) as a standard in industry. This will create many problems in converting from one system of standards to the other.

Response: Originally, 70°F was chosen as the standard temperature because it corresponded to the average mean ambient temperature. This converts to 21.1°C. On March 8, 1974, when EPA changed all units to the metric system, it was decided to round off 21.1°C to 20°C. 20°C converts to 293 K in the International System of Units which EPA now prefers to use. A change now in the standard temperature from 293 K to 298 K would cause confusion among the many Federal and State agencies, private industries, and emission test firms which regularly make use of EPA test methods.

12. Recommended Standards, L-3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16

Comment: The following standards are recommended.

Recommended Standard (ng/J)	No. of Commenters
300[1]	8
380[2]	1
Continue lignite exemption[3]	2
Delay setting standard	2

[1] One commenter recommended 260 ng/J for non-attainment areas; three recommended 300 ng/J for lignite A and 340 ng/J for lignite B (ASTM classifications); another recommended 300 ng/J only for lignite with Na content ≤6 percent and continuing the exemption for lignite with Na content >6 percent.

[2] This commenter alternatively suggested setting separate standards for North Dakota and Texas lignites, based on the nitrogen contents of these fuels.

[3] One commenter recommended continuing the exemption for either North Dakota lignite or all cyclones which burn this fuel.

Response: In developing the final standards, EPA considered these recommendations.

III. ENVIRONMENTAL IMPACT SUMMARY

Air Pollution

The impact of the NO_x emission standards will be most significant in North Dakota and Texas where most new lignite-fired boilers will be located. Although ambient NO_x levels in these areas are now low, emission regulations are important for several reasons:

- The standards will maintain low ambient NO_x concentrations in areas where population and industrial growth is expected in the future.
- The standards will reduce the potential for development of rural smog which can form in regions having initially low ambient NO_x concentrations.
- The standards will reduce long distance transport of NO_x to areas having air pollution problems.

In addition, since nationwide levels of NO_x are expected to rise in the future despite NO_x control regulations, the NO_x emission standards for lignite-fired boilers will help to alleviate this problem.

Mass Emissions: The standards will reduce total NO_x emissions from all new lignite-fired steam generators by about 25 percent, relative to typical emissions from uncontrolled units existing today. This calculation assumes that the present proportion of cyclone, tangential, and horizontally-opposed-fired units in use in North Dakota and Texas will remain unchanged in the future.

By comparison, total NO_x emissions from all new lignite-fired units would have been reduced by about 29 percent if the use of cyclones had been restricted by the originally proposed standard. This assumes that the present proportion of boiler designs remain the same and that all of the cyclone boiler capacity would have been replaced by pulverized-fired units. Thus, it appears that the continued use of cyclone-fired boilers will have only a minor adverse impact on air quality.

Ambient NO_2 Levels: The maximum annual average ground level concentration of NO_x is estimated to be about 1 to 2 $\mu g/m^3$ in the vicinity of a model 450 MW cyclone-fired steam generator. This concentration would be proportionally less for the other boiler designs since these have lower N emission factors. For each boiler design, the maximum concentration would occur 10 to 15 km from the plant. Annual average concentrations of 1 to 2 $\mu g/m^3$ are well below 100 $\mu g/m^3$, the primary national ambient air quality standard for NO_x. The primary standard reflects the maximum ambient concentration of NO_x permissible without endangering public health.

Although the ambient standard for NO_x is exceeded in only four of the 310 air quality control and interstate regions across the country, it is important to note that the ambient standard for oxidants is exceeded in 139 of these regions. Since NO_x is a precursor to oxidant formation, any reduction in ambient NO_x levels will help to alleviate the oxidant problem

Water Pollution

The combustion modifications required to achieve the NO_x emission standards will not create aqueous wastes or thermal pollution. Therefore, the standards will have no impact on water quality.

Solid Waste Disposal

The NO_x emission standards are not expected to alter the proportion of dry bottom and wet bottom boilers in use. Consequently, the relative

amounts of dry and wet ash requiring disposal should not change. The standards will not significantly affect the quantity, quality, or means of disposal of bottom or fly ash.

Energy Considerations

The combustion modifications required to achieve the NO_x emission standards will not decrease boiler combustion efficiency nor require additional power for their operation. Therefore, the standards will have no adverse impact on energy consumption.

SO_2 and Particulate Emissions

The control methods necessary to achieve the NO_x emission standards, if properly operated, will not alter the quality or quantity of SO_2 or particulate matter emitted during combustion.

Socio-Economic Impacts

The standards will cause capital costs for new plants to increase by, at most, only 0.5 percent and operating costs will rise even less. Therefore, capital and operating expenses will rise only nominally. Since the price the consumer pays for electric power is generally proportional to the electric utility's operating costs, consumer power price increases will be negligible. The boiler manufacturers will experience no significant market disadvantage because the standards effectively permit the sale of all boiler designs and provide no sales advantages for any manufacturer. The small increases in capital costs resulting from the standards will not affect the boiler industry's overall sales. The standards will not prohibit the use of any lignite reserves nor adversely affect any other natural resources.